Program Management Process on F/A-18E/F—New Directions

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The F/A-18E/F Program is nearing the end of the Engineering Manufacturing Development (EMD) Phase, and by most measures is considered to be one of the most successful Military Airplane Development Programs in the 1980s and 1990s. This paper will address the new directions taken in managing this program at the Northrop Grumman Corporation as it describes the Program Management Process on the F/A-18E/F Program. The emphasis will be on discussing the trends of change and the real-life implementation of Program Management on a complex aircraft development program with a value greater than $1B. The objective is to contribute to the written body of knowledge on Program and Project Management those things that have served well in the Management of the F/A-18E/F Program at Northrop Grumman.

The Environment in which the Process Must Operate

The environment in which the Program Management process had to operate was characterized by dynamic changes. We were at the end of the cold war. The political focus was on the United States (U.S.) economy and downsizing the defense budget. The Services were revisiting their roles, missions, and budgets. Recent Department of Defense (DOD) Industry performance had been viewed as poor (A-12 cancellation). Industry was undergoing substantial consolidation, which resulted in changing geographically diverse organizations for the major contractors and their suppliers with continuing overhead reductions, a changing workforce, and changing systems. Affordability was paramount. The future promised further budget reductions and consolidations. It was not clear that all of the programs that were starting were affordable with the current political focus and needs.

The Requirement for Success in Today's Terms

The requirement for success in today's terms was simple: "Make No Mistake!" The program was established by Congressional vote with clear technical requirements, schedules for completion of EMD, a development and production cost ceiling, and some degree of controversy on whether the proper review process was employed. There is always competition for the money, and it was clear from the beginning that there was a long line of people who, given the slightest opening, would push to use the money for other purposes, both defense and non-defense related. As the Defense Budget comes down, even healthy programs are at risk; sick programs get canceled. The program requirements were challenging, and the companies involved believed that they had to change the way they operated to succeed on this program.

Leadership—Cultural and Human Facets That Were Stressed

The leadership established the cultural environment for the program as one of "Truth, Trust and Teamwork." The operating principles were: 1) Operate with integrity and mutual respect, and let the shadow of the leadership set the culture; 2) Treat the customer as an ally versus an adversary; 3) Organize in Integrated Product Teams (IPTs) with clear responsibility, authority, and accountability; 4) Focus on facts "what, when, and how versus blaming who"; 5) Use data and metrics that are common to and shared by all to manage the program; 6) Perform to Plan; 7) Improve processes and defects; and 8) Accept and give help when needed.

Communications—Internal and External Techniques Used

In order to facilitate teamwork and communication, several key steps were taken: 1) A credo for working together in mutual respect was established among the key organizations in the program; 2) An organizational "mirroring" between the Navy, Boeing St. Louis, and Northrop Grumman was adopted to provide counterparts down to level V so that there were natural and identified counterpart relationships to nurture; 3) A requirement was established to communicate daily by the counterparts via telecon on the status of their elements of the program; and 4) Media and processes were put in place to facilitate open and honest communications. Examples of these were: 1) Establishment of an on-site presence by each in the other's organization with an open door policy on all

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meetings relative to the conduct of the program; 2)Continuous online sharing of design information in a common shared Unigraphics system; 3) Daily online use of an integrated management information and control system (IMICS); 4) Weekly coast-to-coast regularly scheduled videoconferences; 5) Daily use of profs/FAX and eventually E-mail; 6) Yearly "teamwork building" sessions at rotating sites with all of the key players to focus on improving teamwork and relationships; and 7) Quarterly program reviews at rotating sites of the major contractors and government.

Organization and Planning of the Program—Integrated Product Teams

The Program Management approach was to select the right people, organization, tools, and process to conduct the program. The leaders were handpicked people with development experience and demonstrated technical and management skills. The organization was a collocated integrated team with the following strategy: achieve the maximum degree of concurrency to reduce the formal change cycle and organize around the product and the process of workflow and the life-cycle phases of the product. The core of the organization was three major groups: Product Definition, Product Delivery, and Product Support.

Product Definition has the responsibility to design the product, the tooling, and the test equipment required to build it, manage the supplier development and delivery process of parts for assembly, and define the planning and processes required to build the product. The core of this organization has a team breakdown structure that corresponds to the product breakdown structure, i.e., Three Structures Teams: Forward Center Fuselage Team, Center Fuselage Team, and Aft Fuselage/Vertical Team; and Four Subsystems Teams: Propulsion/Secondary Power Team, Environmental Control System Team, Fuel/Hydraulics/Mechanisms Team and Avionics/Electrical Team, and a New Technology Team and Systems Engineering. In addition, there is a Test and Evaluation Team. These teams are populated with people from Engineering, Procurement, Major Subcontracts, Quality, Tooling, Manufacturing Engineering, Planning, and Cost Control organizations and disciplines with day-to-day direction for work on the program coming from the team leaders and with adherence to functional process requirements oversight by their functional managers.

Product Delivery has the responsibility to build the tooling and assemble the aircraft. The core of this organization has a team structure that maps directly to the Product Definition/Product breakdown structure, i.e., Three Structures Teams and a Final Assembly Team. These teams are populated with people from Manufacturing, Tooling, Quality, Planning, and Cost Control organizations and disciplines. The Product Definition and Product Delivery Teams are collocated and adjacent to the Assembly Area that they are responsible for.

Product Support has the responsibility to see that supportability is incorporated into the design and to provide for all post-delivery support to the product. It manages the logistics of supporting the product including manuals, provisioning, and spares. It also is organized in a team structure that corresponds to the product breakdown structure of the support products.

Systems and Procedures That Were Changed, and Getting to ISO 9000

The number of Systems and procedures that had to change was significant. The Division Systems and procedures were the legacy of many years of functional operation in a non-concurrent process. The General Manager empowered the F/A-18E/F Program to operate as an Integrated Product Team, and we used Program Directives to define and document how we were going to operate differently from the rest of the Division. A Level I Systems Engineering Organization in the Program had responsibility for the Programs Systems and Procedures to support the Teams. Virtually every aspect of how work was conducted changed. One of the beneficial processes for changing processes we acquired from General Electric, a counterpart on the program that gladly shared this as a "best practice." This process is called "work out," and we found it valuable in getting the process stakeholders involved and participating in changing the status quo. After several years of successful operation, this team concept was expanded to include the ongoing F/A-18 C/D program, using the same team structure since the two products are similar. These directives were later converted to Division Standard Practice Procedures, as we became ISO 9000 qualified. Approximately fifty-five hundred procedures were reviewed; 28 percent were okay as written; 36 percent were canceled; 19 percent were revised; and 17 percent were newly created to complete the change. New systems that were put in place were: 1) a new three-dimensional design system (Unigraphics) with links to all key major contractors and suppliers that used geometric dimensioning and tolerancing; 2) a Control and Release System to manage the maturing design and parts of the product (C&RS); 3) an Integrated Configuration Management System (ICMS); 4) a new Integrated Cost and Schedule Control System with Management System Work Station software that broke down and reconciled cost and schedule into the team structure for all program

activities, costs, and milestones; and 5) an Integrated Management Information and Control System (IMICS).

After approximately three years of operation in this IPT structure, we pressed ahead in conjunction with our local DCMC (Defense Contracts Management Command) for ISO 9000 qualification. That effort took about a year-and-a-half from the start to completion of qualification in October 1997.

The Program Control System and Information Network—Changes Made—The Value of Weekly Earned Value

In order to provide the Integrated Product Team Leaders with appropriate and timely data, the program control processes and systems were reengineered. The previous system was made up of linked functional legacy systems updated monthly and reported in a function breakdown where you were a month-and-a-half ago. The revised system provided the Team Leaders, Program Manager, and Customers with a single database for cost and schedule baseline, with the ability to perform weekly performance assessment in a team breakdown.The introduction of weekly earned value has provided the Team Leaders with near real-time performance visibility. Team Leaders now have the means to assess performance, identify problems, and implement corrective action in a timely manner. It is this enhancement that has allowed us to transition EVMS to a management tool rather than a reporting tool.

Use of Program and Product Baselines

One of the significant factors in the success of the program in meeting technical, schedule, and program contract cost requirements was the establishment and control of baselines. These reflected the requirements and allocated down to the team structure technical design-to requirements, configuration baselines, schedule requirements, and budget requirements that were reconciled against the System Spec, Program Master Schedule, and Contract Target Cost. Teams were prohibited from using "private desktop plans" and required to report "online-reconciled" performance assessments for designs, schedules, and costs. This got rid of private databases, improved the integrity of the Program data, and provided an open flow of information to all teams so that each could anticipate the impact on it of any variances by others. Baselines were not allowed to change at the Program level. Changes were allowed at the lowest team level as long as they were internal to the team and did not impact another team. All other changes had to be approved at the Program Change Control Board (CCB).

The Product Workflow Processes—Using Metrics and Trends to Manage by

Product workflow on the F/A-18 Program is the responsibility of the integrated product teams (IPTs). The processes and detailed responsibilities are structured so as to minimize the number of handoffs of work. Key metrics for which Product Definition has responsibility characterize product, process, and tool definition, part procurement, and delivery to the assembly line through successful installation in the assembly. Key metrics for which Product Delivery is responsible characterize tool fabrication, provisioning of standard parts and standard tools, and assembly of the product. Key metrics for which Product Support is responsible characterize defining, ordering and delivery of spares, support data, and support equipment. The teams are all held accountable for product quality, cost, and schedule.

Contractual and technical requirements for the design are flowed to the teams via a systems engineering process. Product and tool design is conducted using a three-dimensional computer-aided-design tool, Unigraphics, utilizing concurrent inputs from the multidisciplinary team. Part-design forms one element of a Build-to-Package, which includes all of the information necessary to build and inspect the part. The Build-to-Package then flows to either an internal or external supplier for fabrication. In the case of components, which are to be procured to a specification, a complete "Buy-to" procurement package is generated, which includes the procurement specification and contract. For build-to-print parts, IPT interface with suppliers is facilitated by Integrated Supplier Management Teams that contain buyers, off-site manufacturing engineers, and quality personnel. Assembly definition is contained in Unigraphics drawings, assembly planning work instructions, and integrated product definition datasheets, which contain additional information on critical joints. Common assembly processes are defined in Assembly Process Work Instructions to ensure process consistency. Parts are delivered to the assembly line in shrink-wrapped kits to ensure accuracy. Deficiencies found by the mechanics assembling the product are recorded on action item boards adjacent to the assembly. Action items are reviewed jointly by the definition and delivery teams and must be acknowledged within twenty-four hours. They can only be closed by the agreement of the initiator.

Quality, cost, and schedule are measured and managed at each step in the process. The metrics are standardized and roll up through the team hierarchy. Team progress is reviewed by program leadership on a rotation, such that each definition and delivery team reports jointly once per week on the status of its product. The data presented

include cost and schedule variance, product quality trends, design and planning quality, milestone schedule performance for all steps in the product flow, part delivery status, technical performance measures, and technical issues and closure plans.

Taking Corrective Action

Having established baselines, data integrity, and metrics to measure trends and deviations from baseline, we then took action based on this data. Teams were rated as blue or green if they were better than or meeting plans (technical, cost, and schedule). Teams were rated as yellow or red if they were not achieving plans, and a recovery plan was required to be established and tracked. If the recovery plan got the team back to the original requirement, then the rating became yellow as long as the recovery plan was being achieved. If a recovery plan did not exist or was not being achieved, then the rating was red. A red rating activated special management attention to help the team with expertise and resources immediately until a satisfactory recovery plan was established. On occasion, this required negotiating impacts with other teams to find a recovery plan that met the Program requirements with a minimum net impact.

The Importance of Integrated Schedules and Common Databases

Performance to plan has been the hallmark of the E/F program and an essential element of the success it has enjoyed so far. Team leaders are responsible for performing to plan and reporting on deviations to plan. An accurate assessment of cost and schedule position on a weekly basis requires development of a comprehensive baseline schedule reflecting a low-risk plan to match the organizational structure of the program. The following ten principles were used to develop the plans and schedules: (1) product focused; (2) team centered; (3) baselined; (4) change controlled; (5) vertically integrated; (6) horizontally integrated; (7) integrated with cost; (8) single sourced; (9) critical path network based; (10) risk mitigated. An accurate assessment of cost and schedule position on a weekly basis also requires development of an accurate, consistent, and integrated database consisting of all elements of the program.

The vertical and horizontal integration of data is crucial to the success of the program because it verifies the connectivity of the lowest level of schedules, the Cost Account Plan (CAP), to the highest level of schedule, the Contract Master Schedule (CMS), and assures an objective assessment of the impact of changes to the final product, providing a comprehensive roadmap to major milestones on the program. A common electronic database eliminates the inconsistencies in the data, assures visibility of the same data to all program elements, assures changes are visible to all business elements, and assures total visibility to the program managers and customers on timely basis.

Keeping Cost and Schedules Integrated

Cost and Schedule integration is established and maintained within a single database. This means one can not independently change the schedule without dealing with the cost implications. Cost account plans with detailed work packages represent the detailed statement of work for the respective teams. Schedule hierarchy is established and maintained within this single database. The weekly EVMS shows performance variances to both cost and schedule of work planned. All work packages reflect the next higher-level cost and schedule element, thus ensuring both vertical and horizontal cost and schedule integration. As a result, both cost and schedule performance baselines are fully integrated and provide integrity with respect to the program baseline. It has been essential that all work in the program be budgeted and scheduled. This prevents the baseline from not reflecting or understating the work to be done.

Change Management Process

Change Management for the F/A-18E/F Program was expanded to include all aspects of program change. Historically, change management has been focused on changes to contract requirements, schedule, cost, and product configuration. The criteria for the F/A-18E/F Program included: requirements, budgets, schedules, product configuration, program tools, technology insertion, process changes, and proposals.

The key factor in managing change was the establishment of baselines for each of the above-noted areas. The establishment of these baselines was implemented through a Program Change Board process.

Once the baseline was established through the Program Change Board, changes were made through multiple-level change authorization. Allocations of the above-noted elements were made to program teams. If a change was needed, and it was within the team allocation, the team leader could authorize the change. If the proposed change exceeded team allocations or affected another team, the authorization moved to the next higher team level. Specific criteria were established for changes that required Program Change Board authorization.

The ability to evaluate the merits of a proposed change was based on the change assessment process.

Each proposed change was documented, using a checklist to assure that all impacts of the change were identified.

This checklist included: change description, change justification, technical impacts, cost, and schedule. The change assessment was then documented on an Integrated Program Change Definition and authorized by the appropriate level team leader. Each change is then tracked to implementation to assure that what was authorized did get implemented. The F/A-18E/F Program Change Process was managed, utilizing an Integrated Change Management System. The Integrated Change Management System provided visibility to all changes in process, authorized, disapproved, and implemented. Additionally, the Integrated Change Management System provided the status of all Deviations/Waivers and all unqualified hardware.

In addition to the Change Control Board at NGC, there is a Joint Change Control Board, with key members of NGC and Boeing, that meets weekly via Video teleconference and uses the same IPCD forms and change criteria to control changes at the total air vehicle level.

Risk Management Process

In the development of a complex product employing numerous new technologies and possessing complicated interfaces, there exists a multitude of uncertainties or risks associated with achieving the program objectives. These risks are unique to the product being developed and the business arrangement between the parties involved in the development. Fundamentally, they can be categorized as events or conditions of the program, which result in the product not meeting the performance or integrity requirements, the schedule for delivery of significant products or data being missed, and/or the cost of the development exceeding available or committed resources. Recognizing that these risks exist at all levels in the Program hierarchy and that in past programs these risks have been realized and probably precipitated program failure, the contractors and the government determined that risks would be managed and that all levels would participate in that management.

The risk management process developed and deployed by NGC involves every member of the development organization in the identification, assessment, planning, and mitigation of risks. Any member of the development team can identify a negative event, state, or condition of the program, which is considered to have some probability of occurrence. With assistance from System Engineering personnel, the identified risk is then formally documented, assessed for severity in terms of the negative consequence and the likelihood, and presented to the manager or team leader who can do something about it. From this point forward, the risk is formally tracked in a system that provides current status, the mitigation plan, and the description of the risk and its assessment. The data is available to all members of the development team through the intranet and to the customer through routine electronic delivery into her data system. The customer's risk management processes are similar and compatible. To provide continuing focus on managing risks, routine risk reviews are conducted within the company and with the USN customer at formal program reviews and technical coordination meetings.

While the risk management process has not eliminated all the surprises from the uncertainties associated with this complex product development, it has significantly reduced the number and, more importantly, minimized the impact when risks are realized. During the course of this EMD Program, over 550 unique risks, which were determined to have significant impact or likelihood of occurrence, have been identified, assessed, and tracked. Fifty percent of these were significant enough to warrant formalized mitigation plans, consisting on the average of more than seven major events, tracked through the integrated team scheduling system. Only 1 percent of the tracked risks was realized and, in every case, the consequence had been mitigated to significantly reduced magnitude.

No formalized management process, including risk management, is without cost. In the absence of a formalized risk program, managers and team leaders still manage risks: it is a fundamental aspect of the management process. The formalized risk management process, however, focuses attention on the early consideration of uncertainties associated with achieving objectives, provides visibility to all potentially affected elements of the organization, and forces integrated resolution of the uncertainty. Additionally, Program Management is provided with a diagnostic for assessing program health and prioritizing and directing resources to the most critical areas affecting the successful outcome of the program. The cost, which can be minimized by a competent tracking, assessment, and reporting system implemented in the intranet, amounts to the added effort required by all team members to contemplate the future, based upon the current state and their experiences. Administration and conduct of the process cost approximately 1.25 persons over the course of the EMD program. The average risk, normalized to cost, had a consequence of approximately $2.7M: not realizing just one because of the risk management process recovered the cost of deployment of this program management tool.

Program Independent Assessment Process

Another unique element of the Program was the establishment of a Program Independent Analysis (PIA) function

within each of the Contractor and Customer organizations. The objective of this function was to conduct independent, unbiased, nonadvocate evaluations of program issues, problems, or potential problems and provide Program Management with reliable, accurate, and factual information proactive in solving or preventing problems that could be damaging to the Program.

Small teams of highly qualified and experienced individuals were established at the Navy Program Office, Boeing-St. Louis, General Electric, and Northrop Grumman. These teams were chartered to have access to Program information at any level to conduct their evaluations. They may operate independently in investigating issues in their own organization or in concert to investigate issues stretching across company/customer boundaries. Their objective is to uncover lead-time-away issues that can cause a significant problem for the program and report independently to the Program Manager after first discussing their findings with the involved teams.

To date, these combined teams have conducted approximately 650 evaluations and continue to provide management with a valuable resource to aid in its quest to anticipate and prevent problems, rather than react to them.

Program Review Process

The F/A-18 Program utilizes many venues to report program performance. Teams of all levels communicate with their counterparts on a daily basis to discuss areas of opportunity, issue resolution, performance status, etc. This communication is accomplished via the telephone, E-mail, fax, video teleconferencing, and formal program reviews. Program reviews are conducted at various levels within the program, Division level, Corporate level, and the total weapon system level. The process of conducting program reviews at the weapon system level is quite formal and unique. Team members have teaming relationships with their program counterparts. This triad relationship exists at the program level among the NGC, Boeing, and the Navy and at the local level between NGC and DCMC. Information is shared in an open, honest, and timely fashion whereby every aspect of the program is worked together toward common goals.

At NGC the review cycle is as follows. Each day is started with a review of one of five sections of the airplane, with the Program Manager and senior Team Leaders in attendance. The people conducting the briefings are the level 4 and 5 Team Leaders (Definition and Delivery) responsible for that part of the airplane. They discuss their weekly EVMS performance and trends, quality and workflow process metrics, and issues. Weekly Program reviews are conducted at the Program Level and cover all aspects of the Program. The people conducting the briefing are the level 2 and 3 Team leaders and business management. The Charts from this review are forwarded to St. Louis for the Boeing Program Manager to review. Division-level reviews were conducted monthly and are now bimonthly. Corporate level reviews are conducted quarterly.

In addition, monthly "Level 1" reviews are conducted at Boeing where the NGC Program Manager briefs NGC's performance to Boeing senior management. Quarterly Navy Program Reviews are conducted at the weapon system level, commonly referred to as Executive Business Reviews (EBR). These rotate their location between NGC, Boeing, and Navy sites. Prior to every review, counterparts agree upon what issues and/or areas of opportunity are to be discussed. This type of teaming provides a uniform view of the issue and allows the team to seek help needed or just status their performance. The process of how these reviews are planned and conducted has proven to be a very effective tool to ensure accountability of program performance.

The Emphasis on Quality and Training

The F/A-18E/F program has established a culture that places the highest priority on quality. The program has shown that improvement in quality has the added benefit of reducing cost. The program approach to quality is defined in the F/A-18 Quality Plan. This plan is structured according to the ANSI/ASQC ISO 9001 elements, each of which is assigned to a product team. Overall responsibility for ensuring quality in all F/A-18E/F Program activities is held by the Program Manager. The F/A-18 Quality Plan places emphasis on above-the-shop floor and process quality, as well as on hardware quality. Deficiencies in quality in any of these areas become the subject of documented findings on which root cause analysis and corrective action are performed. The findings may originate from ISO audits or from any of the day-to-day management activities of the program.

An important aspect of the increasing focus on quality is the movement away from inspection and toward process verification. A key program on the shop floor is the Self Inspection System in which, after training, mechanics become certified to inspect their own work. In order to prepare employees for this increased responsibility, Northrop Grumman and the State of California developed and implemented a far-reaching training program called New Directions. Under this program, shop floor workers receive up to 720 hours of instruction over eighteen weeks. They then take part in a six-week observation period. If successful, they become certified and enter a higher labor grade. To date, 388 employees have successfully completed the program. The dropout rate has been less than 2 percent. Other examples of the movement to

self inspection are the elimination of drawing checkers, delegation of inspection authority to suppliers, and transition of DCMC from signing tags to Material Review Board process verification.

Statistical Process Control (SPC) is applied to key processes on the assembly line as well as in the fabrication centers. The SPC data are collected by the process operators and used by the product teams to reduce process variability. The use of SPC has been a powerful tool in improving and controlling quality.

Quality metrics are tracked in team meetings and in the team hierarchical reporting system. For hardware, defects are tracked by week and by unit. Each week, a Pareto analysis is conducted on each team's defects and reviewed in team meetings. Internal and external escaped defects are collected and analyzed, and first-time process yield is measured and reviewed. Above-the-shop floor, process quality metrics include errors in engineering documentation, errors in assembly planning instructions, and quality of earned value reporting.

The Importance of Affordability

We all know that the end of the "Cold War" and consequently the realigning of national priorities resulted in significantly reduced defense budgets. This event more than ever placed even more pressure to spend the defense dollar wisely. From the government's side, acquisition reform initiatives have taken steps to streamline their processes in order to both reduce timelines from requirements definition to having the equipment in the hands of the user and focus on value for expended dollars. Industry has consolidated in order to be viable with the smaller defense budget. Affordability is a key facet of all defense programs today. So what does it mean to be affordable? It's not necessarily being the cheapest. It does reflect an attitude of meeting the customer's need with a product priced at a value that will give the customer the best mix of acquisition and operational cost. To accomplish this requires good communication between the customer and the suppliers early in the requirements definition phase to treat cost as an independent variable. Both parties must think long term and be willing to put in place measures to mitigate the risk associated with long-term price forecasts for both sides. Throughout the development process design to cost, goals were in place and statused regularly for the air vehicle and the operation and support elements of the program and actively reviewed in the change decision process.

Customer Satisfaction and Customer/Supplier Teaming

To achieve customer satisfaction, we employed the operating principles noted above, "Open and honest communication," "No surprises," and "Treat the customer as an ally versus an adversary." From the beginning, the customers (NAVY PMA, Boeing-St. Louis, and local DCMC) were thoroughly familiar with every phase of planning and execution. All management information systems were available for the customers' review. We sought and received feedback on our efforts through award fee ratings and scorecards. We displayed those internally to our teams and our management and worked to improve and attain superior ratings. We shared rewards with teams for superior awards. Good news or bad, there can be no surprises as you work together toward your common goals. Throughout the development of the Super Hornet, this close relationship provided numerous opportunities to resolve differences before noticeable impacts on cost or schedule were felt. This also built an earned basis for trust and confidence in us by the customer. Additionally, the Department of Defense's principle of Cost as an Independent Variable (CAIV) permitted the program to always review with the customer any individual program requirement which could be relaxed in order to produce a less costly solution. The customer/program team realized significant savings working side by side. Throughout the development period and continuing through the future, teaming with the customer will always produce an improved product in the end. In fact, the customer becomes part of the solution and not a part of the problem!

These same teaming standards apply equally to relationships with your supporting supplier base. Significant efforts are expended to make certain that the suppliers see themselves as part of the team. From the establishment of clear standards of performance to routine communication and visits between the team counterparts and between senior managers, the suppliers must also commit themselves to our mutual teams' success. We conducted surveys with the suppliers through PIA in order to understand what the degree of satisfaction was and determine what actions we could take to improve the relationship. In these days of robust commercial aerospace production, the defense sector now comprises a minority share of the production. As a result, we must use every available technique to insure on-time delivery of quality parts in order to maintain cost and schedule. Good relationships with the supplier base help achieve the program goals.

Summary

The benefits of this approach can be determined by the results. All of our E/F major milestones were achieved on or ahead of schedule. All of our aircraft deliveries were made on or ahead of schedule. All aircraft specification requirements are being met. Our Cum CPI and SPI on the EMD program and on the LRIP program is praiseworthy. The change rate on the F/A-18E/F was one-third of the change rate on F/A-18A/B. The number of defects in manufacturing the E/F during EMD was significantly lower than A/B. We have achieved a 60 percent reduction in the manufacturing defects on the F/A-18C/D since 1995.

The E/F program received the DOD Acquisition in Excellence Award, the AIAA Aircraft Design Award, and the Vision Award for excellence in business performance reporting and has set a high watermark for being a near-model acquisition program. This approach has resulted in outstanding award fees on the EMD contract and the NAVICP Blue Star Award for spares performance on the C/D program. Additionally, we have become a Silver Level Preferred Supplier to Boeing and have become ISO 9001 qualified by our local DCMC.

New Directions Lessons Learned

Integrated Product Teams can make significant improvements in the historical development process but require continual reinforcement to break from old paradigms—Collocation is the difference between the concept and reality of a performing team—Team accountability requires team authority—Weekly earned value is essential—Teams should manage dollars, not just hours—We placed significantly higher resources in dedicated planners in our teams and it paid off—Team leaders must have dedicated, capable business management support—Require common databases and baselines—Require consistent metrics through all team levels in graphic format where trends can be observed and outcomes predicted—Measure deep on key workflow parameters, believe the data, look for the variances to plan, and take swift action to correct them by redirecting resources to the problems—Expect teams to perform to plan—Put your best people on the toughest problems—As the Program Manager of a complex development, understand that something is going wrong everywhere all the time to some degree; your job is to find out lead time away which things will become disasters to the program if not corrected and prevent them from proceeding to happen.